



Integrating value management into sustainable construction projects in Hong Kong

Journal:	<i>Engineering, Construction and Architectural Management</i>
Manuscript ID	ECAM-03-2017-0049.R3
Manuscript Type:	Original Article
Keywords:	Value Management, Construction, Integrated Practice, Questionnaire survey
Abstract:	

SCHOLARONE™
Manuscripts

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

**Integrating value management into sustainable construction projects
in Hong Kong**

Abstract

Purpose

Integrating sustainability into the value management (VM) process can provide a strategic platform for promoting and incorporating sustainable design and development during the lifespans of construction projects. The aim of this study was to investigate the strengths, weaknesses, opportunities and threats (SWOT) for integrating sustainability into the VM process in Hong Kong.

Design/methodology/approach

Following an extensive literature review, 45 attributes were identified and grouped into Strength, Weakness, Opportunity and Threat elements. A questionnaire survey based on these groupings was supported by a semi-structured interviews with public sector clients, value managers and VM facilitators. They shared their experience and views on how to integrate sustainability into the VM exercises.

Findings

The triangulated results of the survey and interviews are presented in this paper. The ranking of the SWOT analysis results indicate that VM does provide opportunities for multidisciplinary professionals and stakeholders to focus on issues relating to society and the environment, which is considered a main strength. The major weakness of integration is the lack of well-trained staff and low levels of VM participant expertise in relation to the

26 sustainable construction issue.

27

28 **Practical implications**

29 There are immense opportunities for integrating sustainability into the VM process, including
30 encouragement of the reduction, reuse and recycling of construction and demolition waste.

31 However, threats presented by integration include the additional time and costs required for
32 achieving sustainability targets.

33

34 **Originality/value**

35 Findings and recommendations provided in this paper should be helpful to decision makers
36 including clients and VM facilitators for the successful integration of the sustainability
37 concept into the VM process.

38

39 **Introduction**

40 Buildings have a massive effect on society, the economy and the environment over their
41 entire life cycles. According to a report released by the United Nations Environmental
42 Programme (UNEP) (2009), buildings consume more than 40% of global energy and
43 contribute up to one-third of global GHG emissions in both developed and developing
44 countries. Around 40% of the total energy consumed by the U.S. and Europe is consumed in
45 residential and commercial buildings (U.S. Department of Energy 2008; Buildings
46 Performance Institute Europe 2011). Buildings consume about 90% of the electricity in Hong
47 Kong, and alone generate around 60% of Hong Kong's GHG emissions (Council for
48 Sustainable Development 2011; Yip and Ho 2013). These have led to the development of
49 'sustainable buildings' that are environmentally responsible and resource-efficient over their
50 development processes.

51

52 Brundtland (1987) defined sustainability as “meeting the needs of the present without
53 compromising the ability of future generations to meet their own needs.” Kibert (1994)
54 defined sustainable construction as “creating a healthy built environment using resource-
55 efficient, ecologically-based principles.” Sustainable construction has generally been
56 described as a process that starts before construction *per se* (in the planning and design stages)
57 and continues after the construction team has left the site (Hill and Bowen 1997).
58 Wolstenholme (2009) emphasised that the construction industry must be modernised by
59 adopting efficient, integrated, innovative and sustainable construction practices. Raising
60 sustainability awareness at the early onset of a project is highly encouraged, to optimise the
61 potential to determine the course of the project. Value management (VM) has the capability to
62 encompass the adoption of the sustainability concept at the conceptual and design stages of a
63 project process (Abidin and Pasquire 2003; 2007).

64

65 Value Management is an organised function-oriented systematic team approach directed at
66 analysing the functions and costs of a system, supply, equipment, service or facility, for the
67 purpose of enhancing its value, through achieving the required functions specified by the
68 clients at the lowest possible overall cost, consistent with requirements for performance
69 (Shen, 1993). The process may be applied to management decision making at any level of an
70 organisation and specifically may be applied to projects, products, systems, services, [and]
71 processes” (AS/NZS 4183, 1994). VM is a proactive, creative, structured, systematic,
72 analytical and multidisciplinary approach to examining project functionality and a wide range
73 of stakeholder requirements to optimise value for money at the lowest overall cost during the
74 project life cycle, from concept to use (Al-Saleh and Taleb 2010; Kelly et al. 2004). It does so
75 by reviewing the costs, quality and functions involved in the project (Myers 2013). VM

76 studies are usually conducted during the early stages of a project to achieve the maximum
77 benefits and resource savings (Norton and McElligott 1995; HM Treasury 1996; Thiry 1997).
78 Although costs and benefits are the primary considerations of VM studies, VM is considered
79 not only a cost-cutting exercise, but rightfully a value-enhancing tool (Al-Saleh and Taleb
80 2010). The project cost should not be reduced at the expense of its functionality and
81 sustainability objectives, which would then diminish its value (Male et al. 1998; Parker
82 1998).

83
84 However, very few studies have investigated how to effectively integrate sustainability issues
85 into the VM process (Schneider 1999; Abidin and Pasquire 2003; Fong 2003; Abidin 2005;
86 Abidin and Pasquire 2005; Abidin and Said 2006; Abidin and Pasquire 2007; Al-Saleh, Taleb
87 2010). The strengths, weaknesses, opportunities and threats of integrating sustainability
88 issues into the VM process should be investigated in practice. This research project seeks to
89 fill this gap. The aim of this paper is to investigate the potential value of integrating
90 sustainability issues into the VM processes in Hong Kong by undertaking a SWOT analysis.
91 The major objectives are to investigate the potential for integrating sustainability
92 considerations into the VM processes by identifying integration strengths and major
93 weaknesses and by developing effective ways of creating opportunities and mitigating any
94 threats to the integration process. Effectively SWOT analysis was used to analyse the current
95 practice with respect to the integration of sustainability considerations into the VM processes
96 and to formulate strategies to make more likely the inclusion of sustainability issues at the
97 project inception stage.

99 **Literature Review**

100 ***Value management and its application in Hong Kong***

101 “The VM process is based on a facilitated participatory workshop involving a
102 multidisciplinary and representative group of people who work together and follow a
103 prescribed job plan to achieve best value or, where appropriate, best value for money for
104 projects, products, systems, services, and processes” (Standards Australia 2007, p. iv). An
105 essential element of the process is that it enables multidisciplinary stakeholders, including
106 clients, consultants, government representatives, end users and the general public, to
107 participate in briefing and design, clarify their needs, attain a better understanding of the
108 project and interests of other stakeholders, build a consensus, and create a sense of ownership
109 and commitment to the solutions that emerge from the VM workshops (Lam 1995; Kelly and
110 Duerk 2002; Yu 2007; Yu et al. 2005a,b; Yu et al. 2006a,b; Yu et al. 2007; 2008). The VM
111 process clarifies project objectives, various stakeholder perspectives and how project
112 objectives may be achieved effectively (Kirk and Spreckelmeyer 1988; Shen 1993). Although
113 its approaches may vary depending on the procurement route chosen, VM is a technique that
114 can be applied to any construction project, and take into account its functional and services
115 requirements over the entire life cycle.

116

117 Value management was first introduced in Hong Kong in 1988 (Shen and Yu 2012). The
118 Environment, Transport and Works Bureau of Hong Kong issued a technical circular
119 demanding that VM studies be carried out in the Public Works Programme (PWP) for major
120 projects with an estimated cost of more than HK\$200 million (equivalent to USD\$15.6
121 million) (Works Bureau 2002). As the works agent for the construction of new government
122 buildings, the Architectural Services Department (ArchSD) of Hong Kong arranged a number
123 of VM studies and still takes a leading role in promoting the integration of sustainability into
124 the VM processes. The ArchSD has been taking proactive measures to uphold the
125 environmental performance of government buildings via comprehensive site planning,

126 sustainable architectural design, the use of green and recycled materials, greenery provisions,
127 waste management, water conservation, the application of energy-efficient measures, the
128 adoption of renewable energy technologies, indoor environmental control, visual effects, low
129 running costs, user comfort and holistic green construction measures at different project
130 stages (Ho and Au 2010). At present moment, ten mega infrastructure projects announced in a
131 2007-08 policy address are being carried out in Hong Kong at a total value of HK\$49.6
132 billion (USD\$6.39 billion), and sustainability issues are being given priority. For example,
133 greening and urban connectivity are being emphasised in the Kai Tak redevelopment project
134 (Architectural Services Department 2011). Although the public sector is encouraged to adopt
135 VM in their projects, there is lack of record for the application of VM in the private sector.

136

137 ***Application of sustainability in VM***

138 Topics of sustainability have been addressed by countless studies (Oke et al, 2015).
139 Transforming strategic sustainability objectives into specific actions for projects is a
140 complicated process (Aarseth et al., 2016; Marcelino-Sádaba et al., 2015). A balance needs to
141 be created between the environmental, economic and social sustainability dimensions
142 (Martens and Carvalho, 2016; Oke et al, 2015). These are considered the “three pillars” of
143 sustainable construction. Integrating sustainability at a very early stage of the construction
144 processes and throughout the project life cycle is essential to the decision making process of
145 project development and project success (Carvalho and Rabechini, 2017). The desire for
146 sustainable development and the new corporate social responsibility ethic adopted by
147 companies are drivers that may also encourage the wider use of VM at the earlier strategic
148 stages (Fewing 2005). The extent to which each of the three pillars applies to a particular
149 construction project and the decision over where to give priority depend on the value
150 judgments of the client, VM facilitator and participants. Although a trade-off is sometimes

151 required between the different sustainability pillars, this trade-off should neither hinder
152 innovative ideas nor compromise the project cost, quality and time objectives (Hill and
153 Bowen 1997). During the workshop stage, brainstorming and group dynamics are key
154 ingredients in the successful delivery of project value for money (Langston and Ding 2001).
155 VM studies must account for different stakeholder needs and expectations. These
156 stakeholders may include senior representatives of client's managerial team, design and
157 project management team, contractor's team and end users. Economic sustainability should
158 not be separated from environmental and social sustainability in proposing alternatives and
159 solutions. In the post-workshop stage, the proposals can be accepted or rejected by senior
160 management. If the proposals are accepted, plans and strategies are formulated to implement
161 them. A conceptual framework for integration of sustainability into value management
162 process is depicted in Figure 1.

[Insert Figure 1 here]

166 Scholars have proposed the notion of integrating sustainability into the VM process at
167 different international conferences organised by the Institute of Value Management (Barton et
168 al. 1999; Alexandre et al. 2006; Yeomans 2002). Abidin's (2005) studies pioneered work in
169 the field. VM enables sustainability to be integrated into the design process of a construction
170 project (Abidin and Pasquire 2003; 2007). A systematic VM job plan can effectively guide
171 the inclusion of sustainability issues during the building life cycle. Although the term
172 "sustainability" may not be used frequently in VM workshops, sustainability aspects such as
173 energy efficiency, waste minimisation, healthy indoor environment, air and water quality,
174 aesthetic effects, low life-cycle costs and user comfort are commonly discussed (Abidin and
175 Pasquire 2005; 2007; Shen and Yu 2012). Sustainability considerations may differ from one

1
2
3 176 VM workshop to another due to the client's unique requirements, commitment to
4
5 177 construction aspects, knowledge of the VM participants and time constraints involved
6
7 178 (Abidin and Pasquire 2005). For example, sustainability issues have been considered on
8
9 179 various U.K. projects such as a sustainable housing project in Crianlarich, Startfilan, where
10
11 180 VM was used to benefit the community (BRE Scotland 2001); sustainable homes and
12
13 181 facilities in Stirlingshire; and the Katrine Water Project at Loch Katrine, Scotland
14
15 182 (Stephenson 2003). The main concerns of the participants when conducting a VM workshop
16
17 183 are identifying and achieving the project objectives. Sustainability issues must be integrated
18
19 184 into VM workshops to achieve sustainability objectives (Abidin and Pasquire 2007).
20
21
22
23

24 186 The general view of the construction industry in Hong Kong is that any application of
25
26 187 environmentally friendly methods involves extra costs and effort (Shen and Tam 2002).
27
28 188 Earlier researchers have identified practical barriers, including time limitations, the absence
29
30 189 of sustainability standard guidance and behavioural barriers such as lack of knowledge and
31
32 190 awareness of sustainability among VM participants, and conflicting perceptions among VM
33
34 191 practitioners of how sustainability should be integrated into the VM process (Abidin and
35
36 192 Pasquire 2005; 2007). Previous studies have focused on investigating the integration of risk
37
38 193 management with VM (Hiley and Paliokostas 2001; Daddow and Skitmore 2004; Othman
39
40 194 2005; Dallas 2006; Hwang et al. 2014). Lin and Shen (2007); Lin et al. (2011) investigated
41
42 195 the strengths and weaknesses of the existing measurement frameworks in the context of VM
43
44 196 studies and identified 18 Key Performance Indicators for measuring VM performance.
45
46 197 Similarly, Ramly et al. (2015) identified 10 critical success factors for VM workshops
47
48 198 implementation in the Malaysian construction industry. However, the intrinsic capabilities of
49
50 199 VM to assist in the incorporation of sustainability aspects early in the briefing and design
51
52 200 stages of the project process have not been fully explored in Hong Kong practice.
53
54
55
56
57
58
59
60

1
2
3 201

4
5 202 **Research Methodology**
6

7
8 203 Both qualitative and quantitative approaches were adopted, including a questionnaire survey
9
10 204 and three semi-structured interviews conducted with a public sector client, a VM participant
11
12 205 and a VM facilitator, respectively. The use of qualitative and quantitative approaches together
13
14 206 to study a research topic – triangulation – is a powerful to gain insights and results, to assist
15
16
17 207 in making inferences and in drawing conclusions (Fellow and Liu, 2015).
18

19
20 208

21
22 209 **Questionnaire survey**
23

24
25 210 The questionnaire was developed by comprehensive literature, discussion between the
26
27 211 research team and a pilot study with three professionals in early of 2015. The
28
29 212 operationalisation of constructs is shown in Table 1. A cluster sampling approach was used in
30
31 213 the questionnaire survey and target survey respondents were selected based on two criteria:
32
33 214 they (i) had had working experience of sustainable construction development and VM, and
34
35 215 (ii) had attended VM workshop(s) either in the role as a facilitator, participant or client. To
36
37 216 solicit the opinions of practitioners, 323 respondents were targeted in Hong Kong. The list
38
39 217 of clients, value managers and VM participants was obtained from different sources including
40
41 218 the Institute of Value Management of Hong Kong. 73 completed survey responses were
42
43 219 received in mid of 2015, representing a response rate of 23%. Over half of the respondents
44
45 220 have been VM participants in VM workshops. 66% of the respondents had participated in one
46
47 221 VM workshop, and that one quarter have been involved in more than five VM workshops.
48
49 222 Around 19% of the respondents were involved with school and education projects, and 12%
50
51 223 were involved with offices, followed by commercial estates, hospital and transportation
52
53 224 projects. Some respondents had experienced more than one type of project and therefore
54
55
56
57
58
59
60

chose more than one type of project for their answers. Around 97% of the respondents had attended VM workshops, and 90% reported that sustainability had been considered in the VM workshops in which they were involved. However, 60% thought that sustainability was not considered as a separate agenda i.e. singled out for special consideration in its own right in the VM workshops, echoing interviewee responses.

Insert Table 1 here

The questionnaire included two sections (a sample of the questionnaire is attached in Appendix A). Section I collected information related to respondent backgrounds, including their involvement in VM studies, their professions, the roles they played in VM studies and the types of projects they were involved in. Section II solicited respondent perceptions of SWOT as a means of analysing the potential for integrating sustainability into VM. SWOT analysis is a strategic planning tool used to evaluate strengths, weaknesses, opportunities and threats related to a project or a business. It involves specifying the objectives and identifying the internal and external factors that may affect the achievement of those objectives (Arslan and Er 2008). The respondents rated their degrees of agreement against each SWOT analysis factor according to a 5-point Likert scale (1= “Strongly disagree” to 5= “Strongly agree”). An additional option of “Do not know” was provided to allow the respondents to express a lack of understanding of the SWOT analysis factors.

Semi-structured interviews

Previous researchers have also conducted semi-structured interviews; for example Daddow and Skitmore (2004); Abidin and Pasquire (2007); Al-Saleh and Taleb (2010), used the semi-structured interview technique with experts in the field of VM and sustainability. Their target survey respondents included construction industry practitioners (clients, project managers,

1
2
3 250 contractors, consultants, property/facilities managers, end users, engineers, academics,
4
5 251 architects and quantity surveyors) working in senior-level positions. Semi-structured
6
7 252 interviews provided an interactive dialogue with a representative of each of these key
8
9 253 respondents to tap into their front-line experience using a common questionnaire.
10
11 254

12
13 255 The three interview participants in this study are key decision makers in VM workshop
14
15 256 (British Standard 2000; Kelly et al. 2003). The interviewees were selected based on their vast
16
17 257 amount of front-line experience with VM and sustainability issues and their influential roles
18
19 258 within their organizations so as to obtain a balanced picture about the integration of
20
21 259 sustainability with the VM process. All three interviewees represent “organisational elites”
22
23 260 and “key informants” and work in key and responsible positions. Interviewing “elite”
24
25 261 personnel is a common qualitative research method, which uniquely yields valuable and
26
27 262 insightful information (Marshall and Rossman 2011).
28
29
30
31 263

32
33 264 Interviewee A was the past president of the Hong Kong Institute of Value Management as
34
35 265 well as the director of a consultancy firm, having first-hand experience of organising more
36
37 266 than 50 VM workshops worldwide. Interviewee B was the client of a public sector project
38
39 267 which won the first environmental award for greenest building in Hong Kong. Interviewee C
40
41 268 was a senior manager of a public sector organization (a fore-runner in promoting sustainable
42
43 269 development), who has participated in different VM workshops.
44
45
46 270

47
48 271 **Data analysis**

49
50
51 272 Data collected by questionnaire survey was analyzed using an SPSS statistical package.
52
53 273 Cronbach’s alpha reliability test, Kendall’s coefficient of concordance W test, the descriptive
54
55 274 statistic were used to analyze the data collected; and the Mann-Whitney U and Kruskal-

Wallis non-parametric tests were used to check for statistically significant differences between the different groups of respondents (i.e., the clients, VM facilitators and VM participants). Data collected by interviews was analysed by coding and content analysis. The following section presents a detailed analysis of the results.

Test of survey reliability

First, Cronbach's alpha was determined to measure the reliability of the data obtained (Nunnally 1978; Nunnally and Bernstein 1994). Table 2 tabulates the coefficient values of Cronbach's alpha for Section B' questions 8-11 (refer to attached sample survey questionnaire). The coefficients range from 0.862 (Q.11) to 0.923 (Q.9). Because all of the coefficients are above 0.70, the collected data are considered to be "reliable" (Nunnally 1978; Nunnally and Bernstein 1994; Geroge and Mallery 2003).

[Insert Table 2 here]

Test of response consistency

Kendall's coefficient of concordance W was used to determine the degree of association and consistency of responses within the groups of questions. W has possible values between 0 and +1. If complete agreement between the different respondents is achieved, a significant W value near to +1 among all of the rank sets emerges. However, if there is no association, the value of W is equal to 0 (Sheskin 2011; Siegel and Castellan 1988). Hypothesis testing will determine whether to *accept* or *reject* the null hypothesis.

H_0 : *there is no association between the rankings given by the respondents.*

H_A : *there is an association between the rankings given by the respondents.*

At the 95% confidence interval, the null hypothesis (H_0) can be rejected if the value of W is at a low level of significance ($p < 0.001$). This rejection of the null hypothesis means that some degree of consensus existed amongst the respondents when answering a particular group of questions. Kendall's W test is suitable when the number of elements (N) in each group of questions is at or below seven. If the number of elements in one question is more than seven, the Chi-square (χ^2) test should be used as the best option (Siegel and Castellan 1988). Table 3 shows the results of applying the Chi-square test to questions 8-11, for which the respondents gave rankings. The final right-hand column in Table 3 shows a rejection of the null hypothesis for questions 8 and 9 (but not questions 10 and 11), indicating that there was some degree of consensus among the respondents. Questions 8 and 9 were rejected because values obtained using Chi-square tests were higher than the critical value of Chi-square and questions 10 and 11 were accepted because the critical values were higher than the Chi-square values obtained using SPSS.

[Insert Table 3 here]

Relative importance index

Sambasivan and Soon (2007) and Gündüz et al. (2013) used the relative importance index (RII method) to determine the relative importance of the various variables. The same method was adopted in this study. RIIs are calculated for each factor as in the following equation:

$$RII = \frac{\sum W}{(A * N)}$$

where RII = relative importance index; W = weighting given to each factor by respondents (ranging from 1 to 5); A = highest weight (i.e., 5 in this case); and N = total number of respondents. The RII value had a range of 0 to 1 (0 not inclusive); the higher the RII, the

323 more important was the factors. The RIIs were then ranked, and the results are shown in
324 Table 4.

325

326 [Insert Table 4 here]

327

328 *The Mann-Whitney U and Kruskal-Wallis tests*

329 A non-parametric Mann-Whitney U Test was conducted to test the hypothesis and study the
330 association of the ordinal (rank order) data with two independent sample groups (drawn from
331 the clients, VM facilitators and VM participants) that did not necessarily have equal sizes or
332 any assumed distributions (Siegel and Castellan 1988; Sheskin 2011). In a Mann-Whitney U
333 test, if the *p-value* is equal to or smaller than a predetermined significance level of 5%, then
334 the two samples are considered to exhibit a statistically significant difference. However, if *p*
335 is larger than ($\alpha = 0.05$), then the two samples are considered to exhibit no difference. H_0 was
336 rejected when the significance levels for the SWOT analysis attributes were found to be equal
337 to or smaller than 0.05. Otherwise, H_A was accepted for the SWOT analysis attributes.

338

339 Table 5 shows significant differences at the 95% confidence level ($\alpha < 0.05$) for the SWOT
340 attributes, including statistical differences between 8(d) “The strategic timing of the VM
341 process enables the sustainability agenda to be highlighted at a critical decision making stage”
342 (between the client and VM facilitator and also between the VM facilitator and participants);
343 8(f) “An effective VM process allows sustainability measures to be integrated during the
344 conceptual and early design stages” (between the client and VM participants and between the
345 VM facilitator and participants); 8(g) “During VM studies, solutions are proposed that
346 promote a safe and healthy environment for the occupants (between the VM facilitator and

1
2
3 347 participants); and 8(h) “Long-term proposal criteria, such as adaptability for future changes,
4
5 348 whole-life costs and select renewable resources, are considered during VM exercises
6
7 349 (between the VM facilitator and participants). Statistical differences were also found between
8
9 350 weakness attribute 9(i) “The lack of technological support for achieving sustainability
10
11 351 objectives (between the client and VM participants); opportunity attributes 10(d) “VM is a
12
13 352 mechanism proved capable of delivering better sustainable value” and 10(g) “The VM
14
15 353 process encourages participants to apply environmentally friendly technologies on site
16
17 354 (between the VM facilitator and participants); and threat attributes 11(d) “The perceived
18
19 355 additional time required for sustainable measures,” 11(e) “The negative perception of green
20
21 356 buildings in terms of the additional cost involved” (between the client and VM participants
22
23 357 and between the VM facilitator and participants) and 11(i) “Ignoring the VM facilitator’s
24
25 358 recommendations for achieving sustainability objectives due to the clients’ limited budgets or
26
27 359 other prior commitments” (between the VM facilitator and participants). Furthermore,
28
29 360 Kruskal-Wallis (K-W) tests were conducted to determine whether other differences between
30
31 361 the respondents affected their perceptions of the relative significance of the SWOT analysis
32
33 362 attributes in integrating sustainability into the VM process (Laerd Statistics 2013). The results
34
35 363 of the K-W tests are shown in Table 6, which depicts only statistically significant different
36
37 364 items at the 95% confidence level ($p < 0.05$) for these attributes 8(d); 8(f); 10(d) and 11(e).
38
39 365 The K-W test is an extension of the t-test and used to compare the means of more than two
40
41 366 samples.
42
43
44
45
46
47

48 368 **[Insert Tables 5 and 6 here]**
49
50

51 369
52 370 *Coding and content analysis*
53
54
55
56
57
58
59
60

Interview data was transcribed into field notes to prepare for analysis. Coding is the process of segmenting and labeling text to form descriptions and broad themes in the data. The objective of the coding process is to make sense out of text data, divide it into text segments, label the segments with codes, examine codes for overlap and redundancy, and collapse these codes into broad themes. The themes consist of no more than two to four words. In this study, the basic steps of conducting content analysis followed the methodology introduced by Fellows and Liu (2015). A qualitative content analysis was adopted. In this method, emphasis is on determining the meaning of the data. Data are given coded allocations to categories and groups of respondents from whom the data were obtained, so that a matrix of categorised data against groups is constructed. Statements can be selected from each cell of the matrix to illustrate the contents of each of the cells. As in any allocation mechanism, the categories should be exclusive (i.e., data assigned to one category only) and exhaustive (i.e., categories cover the research topic comprehensively).

Results and discussions

SWOT analysis is a tool commonly used to scan the internal strengths and weaknesses of a product or service industry and highlight opportunities and threats presented by the external environment (Kurttila et al. 2000; Pasonen et al. 2000; Rauch 2007). It comprises a general, brief and subjective list of attributes or statements that describe the present and future trends of both internal and external environments (Wickramasinghe and Takano 2009). It is also considered a convenient technique for conducting situational assessments. Although SWOT analysis has been conducted in various fields, only a few studies have focused on sustainability and/or VM for infrastructure projects. Lu (2010) conducted a SWOT analysis of construction industry strategic planning. Milosevic (2010) did also from both the investor and contractor viewpoints during the planning, contracting and construction phases of a

1
2
3 396 project. Other researchers have tried to quantify SWOT factors using hybrid methods. For
4
5 397 example, Kurttila et al. (2000) and Yuan (et al. 2012) used a combined SWOT-analytic
6
7 398 hierarchy process (AHP) for public housing projects. In this case, the AHP, a multi-criteria
8
9 399 decision making method for determining the relative importance of attributes within a group,
10
11 400 was used to evaluate the factors identified via SWOT analysis (Saaty 1980). However, the
12
13 401 SWOT-AHP approach is beyond the scope of this research.
14

15
16 402
17
18 403 In this study, strengths are represented by attributes 8(a)-(j), weaknesses by attributes 9(a)-(l),
19
20 404 opportunities by attributes 10(a)-(k) and threats by attributes 11(a)-(l). Table 7 shows the
21
22 405 overall mean values and RII of the SWOT attributes according to the clients, VM facilitators
23
24 406 and VM participants. Contrary to the overall mean values for weaknesses and threats, the
25
26 407 mean values for strengths and opportunities are over 3.50. The respondents might have
27
28 408 believed that integrating sustainability into the VM process presented more strengths and
29
30 409 opportunities than weaknesses and threats. A detailed discussion of the SWOT analysis of
31
32 410 integrating sustainability into the VM process is as follows:
33

34
35 411
36
37 412 **[Insert Table 7 here]**
38

39 413
40
41 414 *Strengths*
42

43
44
45 415 Strengths are the variables associated with an organization's strengths, variables that should
46
47 416 be taken advantage of to promote growth and development of the organization (Kangas et al.
48
49 417 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and relative
50
51 418 ranks of various strengths. The RIIs of all of the attributes related to the strengths of
52
53 419 integrating sustainability into the VM process were above 0.6. It shows the ranking of
54
55 420 attributes from 1 to 5 (i.e., "Strongly disagree," "Disagree," "Neither agree nor disagree,"
56

421 “Agree” and “Strongly agree”). An additional choice of 0 representing “Do not know” was
422 provided to allow the respondents to express a lack of understanding of the SWOT attributes.
423 However, none of the respondents chose the “Do not know” option. The RII of attribute 8(c)
424 “VM provides opportunities for multidisciplinary professionals and stakeholders to become
425 involved and focus on issues relating to society and the environment” was ranked highest by
426 all respondents echoing the findings of Shen and Yu (2012). One of the interviewees stated:
427 “The Kai Tak government offices would be the first government green buildings in Hong
428 Kong. One section of the VM workshop for these government offices was allocated for the
429 brainstorming of green ideas. The Kai Tak government offices are being constructed at the
430 time of writing. Sometimes sustainability is made a key factor of the VM workshops. In one
431 education institution (the Hong Kong Polytechnic University) master plan campus expansion
432 project, a VM workshop was carried out on November 28, 2013. Many ideas were discussed
433 in this workshop, such as the recycling of food waste, whether to retain old buildings and
434 whether it was necessary to build new zero-energy buildings and minimise lifts or escalators
435 (to encourage people to use stairs and walk more to increase their health, and to save
436 electricity).”

437

438 It was noted in the interviews that sustainability was sometimes considered as a separate
439 agenda and integrated into other value drivers such as time, cost and quality. “Sustainability
440 issues are integral to the project functions and objectives, which should be dealt with
441 accordingly during the VM process and should not be treated as a separate agenda” (Abidin
442 and Pasquire 2005, p 178). One of the interviewees (a VM facilitator) noted the following:
443 “In a recent VM workshop focusing on accessibility for the disabled on pedestrian
444 footbridges, we evaluated the energy effectiveness of the air conditioning systems installed in
445 the footbridges. During our ‘option analysis,’ we evaluated how to take out the air

446 conditioning system while also improving the indoor air quality and lift ventilation. We
447 looked at the options of installing solar panels on the lifts. The aim of this workshop was to
448 make the pedestrian lifts more energy efficient (reducing energy consumption) and make
449 them comfortable for pedestrians. That whole VM workshop was focused purely on energy
450 reduction itself, so sustainability considerations were clearly a separate agenda in this case
451 but VM workshops or can alternatively be integrated into other value-enhancing objectives.”

452

453 The attribute 8(i) “Stakeholders are strongly encouraged to propose sustainable solutions at
454 an early stage” and 8(f) “An effective VM process allows sustainability measures to be
455 integrated during the conceptual and early design stage” were ranked second and third. VM
456 ensures that sustainability issues should be brought to the attention of all stakeholders before
457 critical decisions are made (Abidin and Pasquire 2005). The VM facilitator interviewed noted
458 that the VM process should start as early as the feasibility or inception stages: “In a recent
459 (education institution) project related to master planning, the VM workshop was conducted at
460 a very early stage. In the information phase, many green ideas were incorporated into the
461 early design stage. In terms of a functional diagram, the key building functions received by
462 the client were included in this phase. Sustainability of the building could itself be a key
463 function. The functional analysis, brainstorming (creativity), evaluation and implementation
464 phases are the most common phases adopted in most VM workshops. The ideas generated at
465 this point become part of the project brief. Recently sustainability has become included in the
466 design and development stage of most projects. The first question to be asked is whether the
467 existing facilities should be redeveloped or rebuilt. If the services can be provided without
468 rebuilding or demolishing the facilities, how the sustainability objectives can be attained
469 should be looked at. He further elaborated that during the decision making process, the client
470 can determine whether a new building is necessary or whether the refurbishment or extension

of any existing facility can fulfill the client's requirements. In addition, during the VM workshop, the participants were asked to write down the functions of the buildings for the next 50 years. One participant left a blank sheet because during the next 50 years, he felt, no more education institutions would be needed because education may be provided in virtual environments. Management later shortened the planning horizon to 10 years to make it more practical.

Shen and Yu (2012) suggested that VM workshops provide diverse knowledge sources for sustainable development. They further pointed out that a sustainability vision should be discussed as early as possible in the design and briefing stages of a project. Sustainability should be integrated into all of the activities involved in the project design and development processes, with close interactions between the clients and key stakeholders. Attribute 8(g) "During the VM studies, solutions are proposed that promote a safe and healthy environment for the occupants" was ranked last.

Weaknesses

The weaknesses are the variables that may impede or question the need for growth and development of an organisation (Kangas et al. 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and relative ranks of the weaknesses. The RIIs of weaknesses of integrating sustainability into the VM process range from 0.548 to 0.674. Attribute 9(c) "The lack of well-trained staff and expertise of the VM participants in relation to sustainable development" was ranked first, a finding echoed by the interviewees' remarks that Hong Kong lacked well-trained staff and that VM participants may be unaware of sustainability issues. Attribute 9(d) "The lack of client supports in achieving sustainable construction during the VM exercise" was ranked second. However, one interviewee asserted

496 that clients were “willing to achieve sustainability objectives. In some instances, it’s the users
497 who may not be interested in or willing to achieve sustainability objectives. There are many
498 user groups in the Kai Tak government offices. The designer suggested sensor lighting
499 instead of traditional lighting to save energy, but the user groups objected to the idea. There
500 was an option for a bicycle park instead of a car park. The user groups were not happy with
501 this idea and deleted this sustainability option.” The Hong Kong property market also, is not
502 mature in terms of sustainability and lacks awareness and understanding of the basic
503 principles of sustainability (Chen 2013), as well as passive and negative perceptions about
504 integration (Abidin and Pasquire 2005). Attributes 9(i) “The lack of technological support for
505 achieving sustainability objectives” was ranked last among the weaknesses.

506

507 In Hong Kong, some private sector interests invest in sustainable buildings as part of their
508 corporate social responsibility. According to one of the interviewees, “currently there is social
509 pressure on the private sector that stimulates clients to consider sustainable buildings.
510 Private-sector organizations such as the Hong Kong Jockey Club wants to be seen as good
511 members of society, so they want to establish themselves as socially responsible organisations.
512 In the short run, all of these sustainability considerations cost more. They are not cost-
513 reduction measures, and tend to cost more at the initial design and development stages.” He
514 further continued, “in the long run, taking account of life-cycle costs, will benefit the
515 occupants and future generations. Most of these organisations are targeting LEED and BEAM
516 platinum or gold certification. The Hong Kong Jockey Club’s Sha Tin Communications and
517 Technology Centre will be a very environmentally friendly building. This Jockey Club
518 project is targeting gold LEED or BEAM assessment certificates.” However, some of the
519 Hong Kong developers who maximise profit from every square foot rarely care about
520 investing in sustainable buildings. The private-sector developers merely try to meet the

minimum environmental requirements. According to one associate dean of architecture, passive design that takes account of factors such as the orientation of a building in relation to sun and wind patterns and to window-to-wall ratios is crucial. If the design maximises natural lighting and ventilation, considerable energy savings may result without spending a cent on advanced technologies. However, the dean also stressed that the buildings on Hong Kong Island face north to secure harbor views at the expense of natural light (Chen 2013).

Opportunities

Opportunities are those variables an organisation can take advantage of to ensure its future growth and development (Kangas et al. 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and relative ranks of opportunities of integrating sustainability into the VM process. The RIIs of opportunities for integrating sustainability into the VM process were 0.7. Attributes 10(f) “Encouraging the reduction, reuse and recycling of construction and demolition waste” and 10(g) “The VM process encourages participants to apply environmentally friendly technologies on site” were top ranked opportunities of integrating sustainability into the VM process. SAVE International (2007) suggests that VM is a mechanism proved capable of delivering better sustainable value to a project. Similarly, Abidin and Pasquire (2005) recommend producing tools, guidelines, improving knowledge for sustainable integration into the VM process. Promoting the integration of sustainability into the VM process will enhance the reputation of VM as a value enhancing technique and enable it to remain competitive in delivering its services. Furthermore, Shen and Tam (2002) suggest that including sustainability into the VM process will highlight the financial and non-financial incentives of sustainable development to clients and contractors during VM studies. It is necessary that by including sustainability issues the clients and contractors will benefit in monetary and non-monetary terms. Attribute 10(e) “The legal enforcement of environmental

546 protection and the implementation of sustainable practices” was ranked the last opportunity
547 attribute.

548

549 *Threats*

550 Threats are the variables that may affect or prevent the growth of an organisation (Kangas et
551 al. 2001; Yuan et al. 2012). Table 4 shows the minimum, maximum and mean scores and
552 relative ranks of threats. The RIIs of threats to the process of integrating sustainability into
553 the VM process range from 0.586 to 0.718. The majority of the RIIs are greater than 0.6.
554 Attributes 11(d) “The perceived additional time required for sustainable measures”; 11(b)
555 “The client and service provider react passively in fulfilling environmental and social needs”,
556 and 11(e) “The negative perception of green buildings in terms of the additional cost involved”
557 ranked first (RII=0.718), second (RII=0.715) and third (RII=0.677) respectively as major
558 threats to the integration of sustainability issues into the VM process. Abidin and Pasquire
559 (2005; 2007) identified the time limitation as a practical barrier to the integration of
560 sustainability into the VM process. Hence, it is impractical and difficult to address all
561 sustainability issues within a VM workshop. There could also be other potential barriers
562 including perceived extra costs of the integration of sustainability into the VM process. Since,
563 the initial cost of a sustainable building may be 2 to 7 percent higher than the cost of an
564 ordinary building and with a long payback period. As revealed in the interview, Sing Yin
565 Secondary School project has more than double the normal payback period. Furthermore,
566 Williams and Dair (2007); Pitt et al. (2009) and Häkkinen and Belloni (2011) identified
567 different barriers including lack of client demand, awareness and the affordability of
568 sustainable buildings. Meryman and Silman (2004) point out that cost as an important barrier
569 to the implementation of green specifications. The study by Ofori and Kien (2004) in
570 Singapore also found that the perception of extra cost is a fundamental obstacle to the design

team in persuading the clients and other relevant stakeholders to include environmental considerations into the design and construction processes. Extra costs also relate to time, and any delay in workflow caused by green practice would have economic implications. Similarly, Sayce et al. (2007); Sodagar and Fieldson (2008) and Lam et al. (2009) identified “perceived additional cost” as one of the main obstacles to the implementation of sustainable building design in construction projects. Attribute 11(h) “The VM facilitator’s fear of the extra responsibilities involved in highlighting the importance of sustainable development” ranked the lowest potential threat to inclusion in VM workshops.

Implications

This research study has highlighted some important practical implications for clients, contractors and VM practitioners. The study demonstrated that the current practices are generally neglecting integration of sustainability into the VM process due to cost and time constraints. There are ample strengths and opportunities recommended by this study for integrating sustainability into the VM process which are beneficial for the clients and contractors for achieving value for money and meeting sustainability targets.

Limitations and future studies

The major limitation of this study is that the completed survey and interviewees were held in only the one location, i.e., Hong Kong. The results may not be generalisable to other well-developed countries but only to other locations with similar sustainability and VM practicing environments. Therefore, further research should be conducted at other locations and compared with the findings of this SWOT analysis. Moreover, in future research a hybrid SWOT-AHP decision-making method could be applied to a larger sample to make pair-wise comparison between the identified SWOT attributes.

1
2
3 596
4
5 597
6
7
8 598
9
10 599
11
12 600
13
14 601
15
16 602
17
18 603
19
20 604
21
22 605
23
24 606
25
26 607
27
28 608
29
30 609
31
32 610
33
34 611
35
36 612
37
38 613
39
40 614
41
42 615
43
44 616
45
46 617
47
48 618
49
50 619
51
52 620
53
54
55
56
57
58
59
60

Conclusions

This research study is presented as a contribution to understanding the factors affecting the integration of sustainability into the VM process. The study has identified areas of strengths, which support the notion of integrating sustainability into the VM process, and weaknesses, which could be converted into opportunities and threats to be avoided. The results indicate that the strongest factors (strengths and opportunities) relate to the potential for VM exercises to provide for multidisciplinary professionals and stakeholders involvement, and a focus on issues relating to society and a sustainable built environment at the conceptual and design stages of a project to encourage the reduction, reuse and recycling of construction and demolition waste. However, it is recognised that the client needs to strike a balance between economic, social and environmental objectives. The strongest factors (weaknesses and threats) hindering the potential for sustainability integration into the VM process are the lack of well-trained staff and low levels of VM participant expertise in relation to sustainable development and the additional time and resources required to achieve sustainability targets. The perception of extra time and cost was seen as the main obstacle to the implementation of sustainability initiatives. All interviewees observed that sustainability has recently been considered an important issue for both public and private sector projects in Hong Kong, but especially the former. All interviewees agreed that design teams should incorporate sustainability objectives early in the project design and development stages, and that design solutions should not conflict with sustainability and environmental objectives. Both public and private sector clients understand the concept of sustainability and are willing to implement them through the VM process. Along with other value drivers, sustainability should be given priority and should be integrated in the early stages of the VM process for successful project delivery.

621

622 Under the conceptual framework outlines earlier, VM practitioners should incorporate
623 sustainability consideration into VM workshops. The existing target of value creation and
624 enhancement should be expanded to cover environmental improvement and more specifically
625 climate mitigation. Thus, managers may instil better value of money for their projects. On the
626 research front, suitable tools need to be developed to evaluate managers to achieve the above
627 integration with competence and objectivity. SWOT analysis is one such tool.

628

629

630

References

- Aarseth, W., Ahola, T., Aaltonen, K., Økland, A. and Andersen, B. (2016), "Project sustainability strategies: A systematic literature review," *International Journal of Project Management*, available online on 23 December 2016.
- Abidin, N.Z. and Pasquire, C.L. (2003), "Moving towards sustainability through value management," *Proceedings of the Joint International Symposium of CIB Working Commissions W55 and W107*, (2) 258-268, Singapore.
- Abidin, N.Z. (2005), *Using value management to improve the consideration of sustainability within construction*, Doctor of Philosophy, Loughborough University, UK.
- Abidin, N.Z. and Pasquire, C.L. (2005), "Delivering sustainability through value management: concepts and performance overview," *Construction and Architectural Management*, 12(2) 168-180.
- Abidin, N.Z. and Said, I. (2006), "Involvement of sustainability issues in value management: requisite factors," *International Conference of Construction Industry*, Padang, Indonesia, 12-24 June 2006.
- Abidin, N.Z. and Pasquire, C.L. (2007), "Revolutionize value management: a mode towards sustainability," *International Journal of Project Management*, 25(3) 275-282.
- Al-Saleh, Y.M. and Taleb, H.M. (2010), "The integration of sustainability within value management practices: a study of experienced value managers in the GCC countries," *Project Management Journal*, 41(2) 50-59.
- Alexandre, J., Henbriques, J., Catarino, J., Nogueira, A., Rodrigues, F. and Camocho, D. (2006), "How to measure value from a sustainable point of view," *International Conference of the Institute of Value Management*, Brighton, UK.
- Architectural Services Department (2011), *Task Force on Kai Tak Harbour Front Development: Kwun Tong Promenade Stage 2*. (<http://goo.gl/7u2XC1>) (October 10, 2014).
- Arslan, O. and Er, I.D. (2008), "A SWOT analysis for successful bridge team organization and safer marine operations," *Process Safety Progress*, 27(1) 21-28.
- AS/NZS 4183 (1994), *Australian/New Zealand Standard, Value Management*, Joint Technical Committee, OB/6, April.
- Barton, R., Jones, D. and Anderson, H. (1999), "Incorporating the values of ecologically sustainable development into project definitions using soft value management," *International Conference of the Institute of Value Management*, Hong Kong.
- Better Buildings Summit (2003), "Better Buildings Summit Issues Paper," Department of Trade and Industry, HMSO, London, <https://goo.gl/TvRa9D> (Nov. 04, 2017).

- 666 BRE Scotland (2001), *Report on Value Management Workshops for Community Self Build*
667 *Scotland*, BRE Scotland. (<http://goo.gl/rHv5WB>) (Dec. 10, 2013).
- 668 British Standard (2000), BS EN 12973 Value Management, <https://bsonline.techindex.co.uk>.
669 (May 03, 2014)
- 670 Brundtland, G.H. (1987), *Our Common Future: The World Commission on Environment and*
671 *Development*, Oxford University Press, Oxford.
- 672 Buildings Performance Institute Europe (2011), *Final Draft: Principles for Nearly Zero-*
673 *Energy Buildings - Paving the Way for Effective Implementation of Policy Requirements*,
674 Buildings Performance Institute Europe, Brussels.
- 675 Carvalho, M.M. and Rabechini, R. (2017), "Can Project sustainability management impact
676 project success? An empirical study applying a contingent approach," *International*
677 *Journal of Project Management*, available online on 14 March 2017.
- 678 Chen, A. (2013), *Take a Look Inside Sing Yin Secondary School, One of the World's*
679 *Greenest*, Thursday, 14 November 2013, South China Morning Post.
680 (<http://goo.gl/yFNL5v>) (Aug. 06, 2014).
- 681 Council for Sustainable Development (2011), *Combat Climate Change: Energy Saving and*
682 *Carbon Emission Reduction in Buildings*, Hong Kong SAR, China.
683 (<http://goo.gl/ZjpGw8>) (Aug. 06, 2014).
- 684 Daddow, T. and Skitmore, M. (2004), "Value management in practice: an interview survey,"
685 *Australasian Journal of Construction Economics and Building*, 4(2) 11-18
686 (<http://goo.gl/KR7vjp>).
- 687 Dallas, M. (2006), *Value and risk management: A guide to best practice*, Blackwell
688 Publishing, Oxford.
- 689 Fellows, R. and Liu, A. (2015), *Research Methods for Construction*, 4th edn., Wiley
690 Blackwell, Oxford.
- 691 Fewing, P. (2005), *Construction Project Management: An Integrated Approach*, Taylor &
692 Francis, Oxon.
- 693 Fong, S.W. (2003), "Value management – going all out for knowledge creation," *The Value*
694 *Manager*, 9(1) available at (<http://goo.gl/IEIXIqo>) (Aug 20, 2015).
- 695 Geroge, D. and Mallery, P. (2003), *SPSS for Windows Step by Step: A Simple Guide and*
696 *Reference. 11.0 Update*, 4th edn., Allyn and Bacon, Boston.
- 697 Gündüz, M., Nielsen, Y. and Özdemir, M. (2013), "Quantification of Delay Factors Using the
698 Relative Importance Index Method for Construction Projects in Turkey," *Journal of*
699 *Management in Engineering*, 29(2), 133-139.
- 700 Häkkinen, T. and Belloni, K. (2011), "Barriers and drivers for sustainable building," *Building*
701 *Research & Information*, 39(3), 239-255.

- 702 Hill, R.C. and Bowen, P.A. (1997), "Sustainable construction: principles and a framework for
703 attainment," *Construction Management and Economics*, 15(3) 223-239.
- 704 Hiley, A. and Paliokostas, P.P. (2001), "Value management and risk management: An
705 examination of the potential for their integration and acceptance as a combined
706 management tool in the U.K construction," *Construction Industry Proceedings of COBRA*
707 2001, Royal Institution of Chartered Surveyors, London, U.K. (<https://goo.gl/Reb2oT>)
708 (Jan 9, 2015).
- 709 HM Treasury (1996), *Central Unit on Procurement Guidance No. 54 Value Management*,
710 The Stationary Office. (<http://goo.gl/TKpc5L>) (July 04, 2014).
- 711 Ho, S.K. and Au, W.Y.V. (2010), "Optimizing the environmental performance of
712 government buildings and facilities," *The Sixteenth Annual International Sustainable*
713 *Development Research Conference, 30 May-1 June, 2010* The Kadoorie Institute, Hong
714 Kong. (<http://goo.gl/Bt8dPT>) (Jan. 09, 2014).
- 715 Hwang, B., Zhao, X. and Ong, S. (2014), "Value management in Singaporean building
716 projects: implementation status, critical success factors, and risk factors," *Journal of*
717 *Management in Engineering*, 04014094.
- 718 Kangas, J., Pesonen, M., Kurttila, M. and Kajanus, M. (2001), "Integrating AHP with SWOT
719 analysis," *Proceedings of the Sixth Int. Symposium on the Analytic Hierarchy Process*,
720 *Institute for Accounting and Controlling*, p. 189-198, University of Berne, Berne,
721 Switzerland.
- 722 Kelly, J. and Duerk, D. (2002), "Construction Project Briefing/Architectural Programming,"
723 *Best Value in Construction*, eds. J. Kelly, R. Morledge and S. Wilkinson,) 38-58,
724 Blackwell Science Ltd.
- 725 Kelly, J., Hunter, K. and Male, S. (2003), "The client's value system explored: case studies
726 from the UK public sector," In *Proceedings of the joint International Symposium of CIB*
727 *Working Commissions W55, W65 and W107, Knowledge in Construction 1*, Singapore,
728 October 22-24, 2003, 423-433.
- 729 Kelly, J., Male, S. and Graham, D. (2004), *Value Management of Construction Projects*,
730 Wiley-Blackwell Science Ltd., Oxford.
- 731 Kibert, C.J. (1994), "Final Session," *First International Conference of CIB TG 16 on*
732 *Sustainable Construction, 6-9 November 1994*. Tampa, FL.
- 733 Kirk, S.J. and Spreckelmeyer, K.F. (1988), *Creative Design Decisions*, Van Nostrand
734 Reinhold Company, New York.
- 735 Kurttila, M., Pesonen, J., Kangas, M. and Kajanus, M. (2000), "Utilizing the analytic
736 hierarchy process (AHP) in SWOT analysis: a hybrid method and its application to a
737 forest-certification case," *Forest Policy and Economics*, (1) 41-52.
- 738 Laerd Statistics (2013), *Kruskal-Wallis H Test using SPSS Statistics*. (<http://goo.gl/TTdjC9>)
739 (on September 29, 2014. Lund Research Ltd.

- 740 Lam, P.T.I. (1995), "Applications of value engineering in the construction industry," *The*
741 *Asia Pacific Building and Construction Management Journal*, (1) 18-24.
- 742 Lam, P.T.I., Chan, E.H.W., Chau, C.K., Poon, C.S. and Chun, K.P. (2009), "Integrating
743 Green Specifications in Construction and Overcoming Barriers in their Use," *Journal of*
744 *Professional Issues in Engineering Education and Practice*, 135(4), 142-152.
- 745 Langston, C.A. and Ding, G.K. (2001), *Sustainable Practices in the Built Environment*, 2nd
746 edn., Butterworth-Heinemann, Oxford.
- 747 Lin, G., Shen, G., Sun, M. and Kelly, J. (2011), "Identification of key performance indicators
748 for measuring the performance of value management studies in construction," *Journal of*
749 *Construction Engineering and Management*, 137(9), 698-706.
- 750 Lin, G. and Shen, Q. (2007), "Measuring the performance of value management studies in
751 construction: Critical Review," *Journal of Management in Engineering*, 23(1), 2-9.
- 752 Lu, W. (2010), "Improved SWOT Approach for conducting strategic planning in the
753 construction industry," *Journal of Construction Engineering and Management*, 136(12)
754 1317-1328.
- 755 Male, S., Kelly, J., Fernie, S., Grönqvist, M. and Bowles, G. (1998), *The Value Management*
756 *Benchmark: A Good Practice Framework for Clients and Practitioners*, Thomas Telford
757 Publishing, London.
- 758 Marcelino-Sádaba, S., González-Jaen, L.F. and Pérez-Ezcurdia, A. (2015), "Using project
759 management as a way to sustainability. From a comprehensive review to a framework
760 definition," *Journal of Cleaner Production*, 99, 1-16.
- 761 Marshall, C. and Rossman, G.B. (2011), *Designing qualitative research*, 4th edn, SAGE
762 Publications, Inc., California.
- 763 Martens, M.L. and Carvalho, M.M. (2016), "Key factors of sustainability in project
764 management context: A survey exploring the project managers' perspective," *International*
765 *Journal of Project Management*, available online on 14 May 2016.
- 766 Meryman, H. and Silman, R. (2004), "Sustainable engineering—Using specifications to make
767 it happen," *Structural Engineering International (IABSE, Zurich, Switzerland)*, 14(3),
768 216-219.
- 769 Milosevic, I. (2010), "Practical application of SWOT analysis in the management of a
770 construction project," *Leadership and Management in Engineering*, 10(2) 78-86.
- 771 Myers, D. (2013), *Construction Economics: A New Approach*, 3rd edn., Routledge, Oxon.
- 772 Norton, B.R. and McElligott, W.C. (1995), *Value Management in Construction*, Macmillan
773 Press, London.
- 774 Nunnally, J.C. (1978), *Psychometric Theory*, 2nd edn., McGraw-Hill, New York.

- 775 Nunnally, J.C. and Bernstein, I.H. (1994), *Psychometric Theory*, McGraw-Hill, Sydney.
- 776 Ofori, G. and Kien, H.L. (2004), "Translating Singapore architects' environmental awareness
777 into decision making," *Building Research & Information*, 32, (1), 27-37.
- 778 Oke, A. E., and Aigbavboa, C. O. (2017), "Sustainable Value Management for Construction
779 Projects," Springer.
- 780 Oke, A.E., Aghimen, D.O. and Olatunji, S.O. (2015), "Implementation of Value Management
781 as an economic sustainability tool for building construction in Nigeria," *International
782 Journal of Managing Value and Supply Chains*, 6(4), December, 55-64.
- 783 Organisation for Economic Co-operation and Development (2010), "Regulatory Policy and
784 the Road to Sustainable Growth," <https://goo.gl/UWQvPH> (Nov. 30, 2017).
- 785 Othman, A.A. (2005), "Value and risk management protocol for dynamic brief development
786 in construction," *Emirates Journal Engineering Research*, 10(2), 23-26.
- 787 Parker, D.E. (1998), *Value Engineering Theory*, The Lawrence D. Miles Value Foundation,
788 Washington, DC.
- 789 Pasonen, M., Kurttila, M., Kangas, J., Kajanus, M. and Heinonen, P. (2000), "Assessing the
790 priorities using A'WOT among resource management strategies at the Finnish forest and
791 park service," *Forest Science*, 47(4) 534-541.
- 792 Pitt, M., Tucker, M., Riley, M. and Longden, J. (2009), "Towards sustainable construction:
793 promotion and best practices," *Construction Innovation*, 9, 201-224.
- 794 Ramly, M.Z., Shen, G. and Yu, A. (2015), "Critical success factors for value management
795 workshops in Malaysia," *Journal of Management in Engineering*, 31(2), 05014015-7.
- 796 Rauch, P. (2007), "SWOT analyses and SWOT strategy formulation for forest owner
797 cooperations in Austria," *European Journal for Forest Research*, 126(3) 413-420.
- 798 Saaty, T.L. (1980), *The Analytic Hierarchy Process: Planning, Priority Setting, Resource
799 Allocation*, McGraw-Hill, New York.
- 800 Sambasivan, M., and Soon, Y. W. (2007). "Causes and effects of delays in Malaysian
801 construction industry," *International Journal of Project Management*, 25(5), 517-526.
- 802 SAVE International (2007), *Value Standard and Body of Knowledge*. (<http://goo.gl/ob9C8r>)
803 (July 23, 2014).
- 804 Sayce, S., Ellison, L. and Parnell, P. (2007), "Understanding investment drivers for UK
805 sustainable property," *Building Research & Information*, 35, 629-643.
- 806 Schneider, M. (1999), "Value management and sustainability: an opportunity to revolutionize
807 the construction industry," *Managing Sustainable Values, Proceedings of the International
808 Conference of the Institute of Value Management Hong Kong*, 6-7 May, 1999.

- 809 Shen, G. Q., Yu, A. T., and Chung, J. K. (2015), "6 VM Applications," *Value Management in*
810 *Construction and Real Estate: Methodology and Applications*, 66.
- 811 Shen, G.Q. and Yu, A.T.W. (2012), "Value management: recent developments and way
812 forward," *Construction Innovation: Information, Process, Management*, 12(3) 264-271.
- 813 Shen, L.Y. and Tam, V.W.Y. (2002), "Implementation of environmental management in the
814 Hong Kong construction industry," *International Journal of Project Management*, 20(7)
815 535-543.
- 816 Shen, Q.P. (1993), *A Knowledge-Based Structure for Implementing Value Management in the*
817 *Design of Office Buildings*, PhD thesis, University of Selford, British Library, Document
818 Supply Centre, UK.
- 819 Shen, Q.P., Brandon, P. and Baldwin, A. (2009), *Collaborative Construction Information*
820 *Management*, Spon Press, Oxon.
- 821 Sheskin, D.J. (2011), *Handbook of Parametric and Nonparametric Statistical Procedures*,
822 5th edn., Chapman and Hall/CRC.
- 823 Siegel, S. and Castellan, N.J. (1988), *Nonparametric Statistics for the Behavioral Sciences*,
824 2nd edn., McGraw-Hill, New York.
- 825 Sodagar, B. and Fieldson, R. (2008), "Towards a sustainable construction practice,"
826 *Construction Information Quarterly*, 10, 101-108.
- 827 Standards Australia (2007), *Australian Standards: Value Management*, Standards Australia,
828 Sydney.
- 829 Stephenson, M. (2003), *How Can Value Engineering be used to Enhance the Sustainability of*
830 *Major Engineering Developments?* MSc Dissertation, University of Strathclyde, United
831 Kingdom.
- 832 Tahir, M. Z., Nawi, M. N. M., and Ibrahim, A. (2016), "Value Management (VM): A
833 Strategic Approach for Improving Energy Efficiency," *International Journal of Supply*
834 *Chain Management*, 5(4).
- 835 Thiry, M. (1997), *Value Management Practice*, Project Management Institute, Newtown
836 Square, PA.
- 837 U.S. Department of Energy (2008), *Energy Efficiency Trends in Residential and Commercial*
838 *Buildings*, U.S. Department of Energy's Office of Energy Efficiency and Renewable
839 Energy, U.S.A.
- 840 UNEP (2009), *Building and Climate Change: Summary for Decision-Makers*, United Nations
841 Environment Programme, Paris.
- 842 Wickramasinghe, V. and Takano, S. (2009), "Application of combined SWOT and analytic
843 hierarchy process (AHP) for tourism revival strategic marketing planning: a case of Sri

- 844 Lanka tourism," *Journal of the Eastern Asia Society for Transportation Studies*, (8) 954-
845 969.
- 846 Williams, K. and Dair, C. (2007), "What is Stopping Sustainable Building in England?
847 Barriers Experienced by Stakeholders in Delivering Sustainable Developments,"
848 *Sustainable Development*, 15, 135-147.
- 849 Wolstenholme, A. (2009), *Never Waste a Good Crisis: A Review of Progress since*
850 *Rethinking Construction and Thoughts for Our Future*, Construction Excellence, London.
- 851 Works Bureau (2002), *Technical Circular No. 35/2002, Environment, Transport and Works*
852 *Bureau Technical Circular, Implementation of Value Management in Public Works*
853 *Projects*, Environment, Transport and Works Bureau, Hong Kong SAR, China.
- 854 Yao, R. (2013), *Design and Management of Sustainable Built Environments*, Springer,
855 London.
- 856 Yates, A. (2003), *"Sustainable buildings: benefits for constructors," Building Research*
857 *Establishment London*.
- 858 Yeomans, P. (2002), "Environmentally sustainable development plus value management
859 equals results minus rhetoric," *International Conference of the Institute of Value*
860 *Management* Hobart, Australia.
- 861 Yip, C.H. and Ho, W.Y. (2013), "Enhancing building energy efficiency - a concerted effort of
862 the trade and the government," *Proceedings of 4th Greater Pearl River Delta Conference*
863 *on Building Operation and Maintenance - Sustainable Operation and Maintenance for*
864 *Green Buildings*, 12 December 2013. (<http://goo.gl/cDhJ2d>) 103-107, EMSD, Hong
865 Kong SAR, China.
- 866 Yu, A.T.W. (2007), *"A Value Management Framework for Systematic Identification and*
867 *Precise Representation of Client Requirements in the Briefing Process,"* Doctor of
868 Philosophy, The Hong Kong Polytechnic University, Hong Kong SAR, China.
- 869 Yu, A.T.W., Shen, Q.P. and Chan, E.H.W. (2005a), "An analytical review of the briefing
870 practice in Hong Kong's construction industry," *The International Journal of*
871 *Construction Management*, 5(1) 77-89.
- 872 Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2005b), "Application of value management
873 in project briefing," *Facilities*, 23(7/8) 331-342.
- 874 Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2006a), "An investigation of the critical
875 success factors in construction project briefing by way of content analysis," *Journal of*
876 *Construction Engineering and Management*, ASCE, 132(11) 1178-1186.
- 877 Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2007), "An empirical study of the variables
878 affecting construction project briefing/architectural programming," *International Journal*
879 *of Project Management*, 25(1) 198-212.

- 1
2
3 880 Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2008), "A comparative study of the
4 881 variables in construction project/architectural programming," *Journal of Construction*
5 882 *Engineering and Management*, 134(2) 122-138.
6
7 883 Yu, A.T.W., Shen, Q.P., Kelly, J. and Lin, G.B. (2006b), "A value management approach to
8 884 strategic briefing: an exploratory study," *International Journal of Architectural*
9 885 *Engineering and Design Management*, 2(4) 245-259.
10
11 886 Yuan, J., Guang, M., Wang, X., Li, Q. and Skibniewski, M. (2012), "Quantitative SWOT
12 887 analysis of public housing delivery by Public-Private Partnerships in China based on the
13 888 perspective of the public sector," *Journal of Management in Engineering*, 28(4) 407-420.
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

 Department of Building and Real Estate, The Hong Kong Polytechnic University
Project entitled “ **SWOT analysis of integrating sustainability into the value management process for construction projects**”

I. About the Respondent *(Only overall statistical data will be compiled, i.e., individuals not identifiable)*

1. Have you ever been involved in value management (VM) workshop(s) (to-date)?
☐ Yes ☐ No *(Please pass a blank copy to someone whom you know with such experience)*
2. If yes, how many VM workshops have you ever been involved with?
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ more than 5
3. Your general role:
☐ Client/Project Manager ☐ Contractor ☐ Sub-contractor ☐ Property/Facilities Manager
☐ End User ☐ Engineer ☐ Environmental Expert ☐ Academic ☐ Architect ☐ Quantity Surveyor
☐ Other pls. specify: _____
4. Your role in VM exercise(s)?
☐ Client ☐ VM Facilitator ☐ VM participants or team member
5. Is sustainability considered in VM workshops which you were involved with?
☐ Yes ☐ No
6. Is sustainability regarded as a separate agenda in VM workshop(s)?
☐ Yes ☐ No
7. Which of the following types of projects have you been involved with? (More than one box may be selected)
☐ Commercial Estate ☐ Offices ☐ Entertainment and Exhibition Centre
☐ Hospital ☐ Transportation ☐ Water Supply & Treatment ☐ Power & Energy
☐ ICT (Information & Communication Tech) ☐ Housing Estate ☐ Police & Prison
☐ School & Education ☐ Waste Management (Landfill) ☐ Others (please specify) _____

Please rate the following statements based on a scale from 0 – 5, where “0” represents “Do not know”, “1” “Strongly disagree”, “3” “Neither agree nor disagree” and “5” represents “Strongly agree”.

II. SWOT Analysis of Sustainability integration into Value Management

8. Please rate the following statements regarding the relative frequency of the following <u>strengths</u> of Sustainability integrating into VM	0	1	2	3	4	5
a) VM workshops recommend solutions for energy and resource efficient buildings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) VM workshops provide diverse knowledge sources for sustainable development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) VM provides opportunities for multi-disciplinary professionals and stakeholders’ involvement to focus on issues relating to society and environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Strategic timing of VM process enables sustainability agenda to be highlighted at a critical decision making stage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) VM promotes sustainable design for a project	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Effective VM process allows integration of sustainability measures during	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

the conceptual and early design stage						
g) During VM studies, solutions are proposed which promote safe and healthy environment for occupants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Consider long-term criteria in proposals i.e. adaptability for future changes, whole-life costs, select renewable resources etc. during VM exercises	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) Encourage strong participation of stakeholders for proposing sustainable solutions at a very early stage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) Recommend optimum utilisation of natural resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) Others, pls. specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Please rate the relative frequency of the following <u>weaknesses</u> of Sustainability integrating into VM	0	1	2	3	4	5
a) Lack of government legal enforcement of sustainability policies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Additional management and operational cost of project for sustainability measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Lack of well trained staff and expertise of VM participants about sustainable development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Lack of client's support in achieving sustainable construction during VM exercise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Lack of contractors, sub-contractors and suppliers' cooperation for achieving sustainability goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Lack of incentives for clients/contractors for achieving sustainable development goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Unclear project brief, poor specifications or inadequate business cases for achieving sustainable development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Difficult to enforce environmental performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) Lack of technological support for achieving sustainability objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) Lack of integration of sustainability into VM studies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) Lack of sustainable construction guidance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) Not highlighting corporate social responsibility for achieving environmental and sustainable needs of society during VM process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m) Others, pls. specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. Please rate the relative frequency of the following <u>opportunities</u> of Sustainability integrating into VM	0	1	2	3	4	5
a) Inclusion of sustainability issues early in the VM practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Introduce sustainability guidance for VM practitioners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Promote client's interest on sustainability as a primary value driver	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Prove VM capability as a mechanism to deliver better sustainable value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Legal enforcement on environmental protection and implementation of sustainable practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Encourage reduction, reuse and recycling of construction and demolition waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Encourage to apply environmentally friendly technologies on site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Provide in-house training on environmental management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) Establish waste management plan during VM exercise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) Inclusion of environmental scoring in tender process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) Highlight financial and non-financial incentives of sustainable development for clients and contractors during VM studies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) Others, pls. specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. Please rate the relative frequency of the following <u>threats</u> of Sustainability integrating into VM	0	1	2	3	4	5
a) Client's strategic planning do not incorporating sustainability objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Passive reaction by the client and service provider for fulfilling environmental and social needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Belief that trade-off requirements among the principles of sustainability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Perceived additional time required for sustainable measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Negative perception of green buildings in terms of additional cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Strong perception that integration of sustainability issues into VM studies may slow down the progress of the studies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Lack of knowledge, understanding and importance of sustainable development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) VM facilitator's fear of extra responsibilities for highlighting importance of sustainable development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) Ignoring VM facilitator recommendations for achieving sustainability objectives due to clients' limited budget or other prior commitments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) No end users' involvement in sustainable design and development process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) No compulsory regulations for implementing sustainable development measures, implementation is only an option	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) Corporate image could be damaged for not implementing sustainable practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m) Others, pls. specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Further comments on Integration of Sustainability into VM

Please return the completed questionnaire to Dr. Ann Yu, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, by post, email ann.yu@polyu.edu.hk, or fax: (852) 2764 5131.

If you are interested in receiving the overall results, please provide the following details:

Name: _____	Position: _____
Organization: _____	
Address: _____	
Telephone No.: _____	Fax No.: _____ Email address: _____

****End of questionnaire****

Thank you for your cooperation!

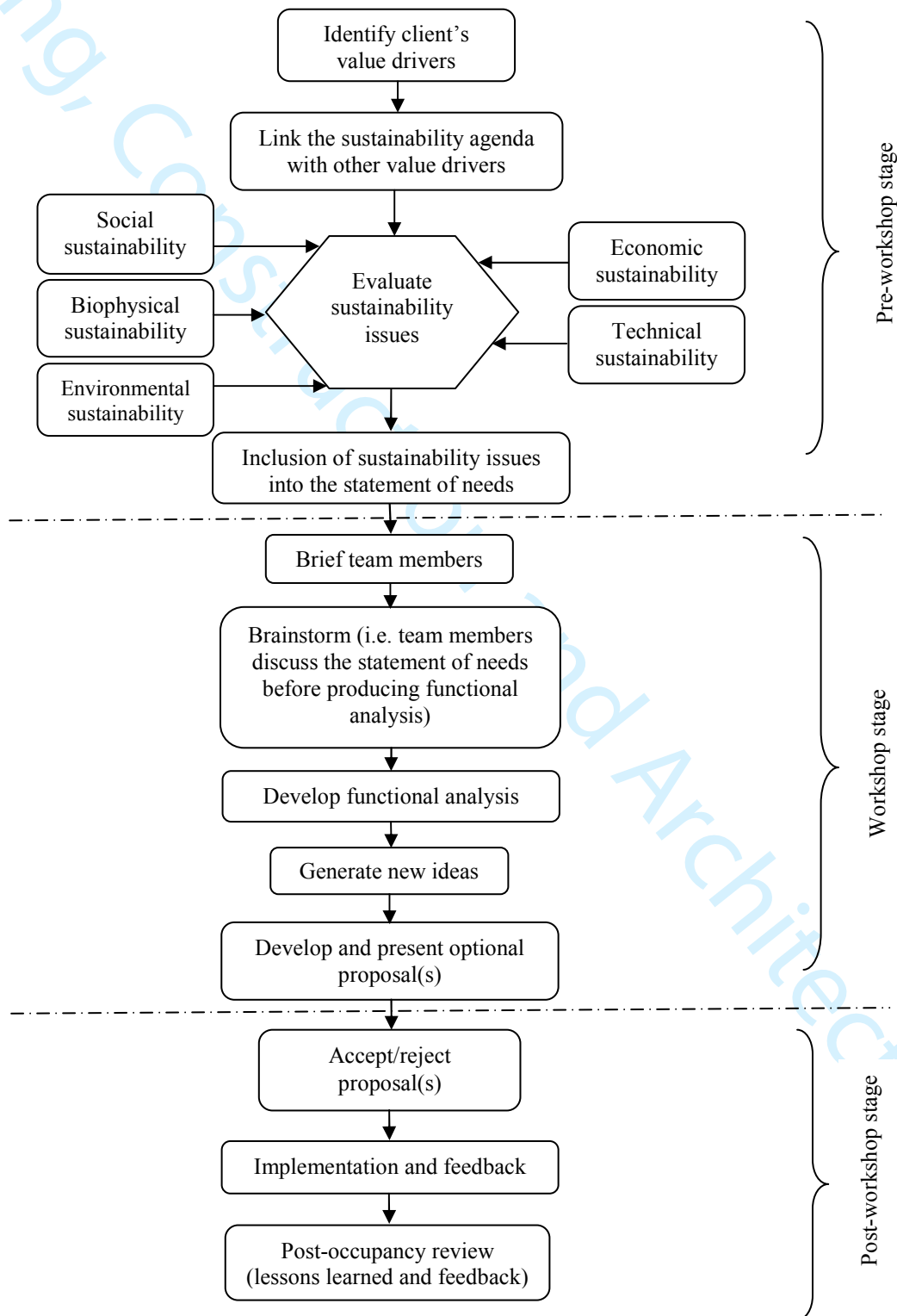


Figure 1: Stages of integration of sustainability into value management process (adapted from Abidin and Pasquire 2007)

Table 1. Operationalization of constructs

	VM Attributes	References
Strengths	VM provides opportunities for multidisciplinary professionals and stakeholders to become involved and focus on issues relating to society and the environment	(Shen and Yu 2012)
	Stakeholders are strongly encouraged to propose sustainable solutions at an early stage	
	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	(Fewing 2005)
	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	(Ramly et al. 2015)
	The VM workshops provide diverse knowledge sources for sustainable development	(Shen and Yu 2012)
	The VM workshops recommend solutions for energy- and resource-efficient buildings	(Tahir et al. 2016)
	Long-term proposal criteria, such as adaptability for future changes, whole-life costs and select renewable resources, are considered during VM exercises	(Fewing 2005)
	VM promotes sustainable project design	(Yeomans 2002)
	The optimum use of natural resources is recommended	(Better Buildings Summit 2003)
	During VM studies, solutions are proposed that promote a safe and healthy environment for the occupants	(Yates 2003)
Weaknesses	The lack of well-trained staff and expertise of VM participants in relation to sustainable development	(Al-Saleh and Taleb 2010)
	The lack of client support in achieving sustainable construction during the VM exercise	
	Unclear project briefs, poor specifications or inadequate business cases for achieving sustainable development	(Oke and Aigbavboa 2017)
	The lack of incentives for clients/contractors to achieve sustainable development goals	
	The additional management and operational costs of sustainability measures for the project	(Al-Saleh and Taleb 2010)
	The lack of legal government enforcement of sustainability policies	(Organisation for Economic Co-operation and Development 2010)
	The difficulty of enforcing environmental performance	(Al-Saleh and Taleb 2010)
	The lack of contractor, sub-contractor and supplier cooperation in achieving sustainability goals	(Oke and Aigbavboa 2017)
	The VM facilitator and/or client does not highlight the role of corporate social responsibility in achieving the environmental and sustainable needs of society during the VM process	
	The lack of sustainability integration into VM studies	(Abidin and Pasquire 2005; Abidin and Pasquire 2007)
Opportunities	The lack of sustainable construction guidance	(Al-Saleh and Taleb 2010)
	The lack of technological support for achieving sustainability objectives	(Abidin and Pasquire 2005)
	Encouraging the reduction, reuse and recycling of construction and demolition waste	(Abidin and Pasquire 2005; Fewing 2005)
	The VM process encourages the application of environmentally friendly technologies on site	(Abidin and Pasquire 2005)
	Promoting the client's interest in sustainability as a primary value driver	(Abidin and Pasquire 2005)
	Including sustainability issues in the VM practices early on	(Abidin and Pasquire 2005)
	VM is a mechanism proved capable of delivering better sustainable value	(Fewing 2005)
	Highlighting the financial and non-financial incentives of sustainable development for clients and contractors during VM studies	
	Establishing a waste management plan during VM exercises	
	Introducing sustainability guidance for VM practitioners	(Abidin and Pasquire 2005)
Threats	Including environmental scoring in the tender process	
	Providing in-house training for environmental management	
	The legal enforcement of environmental protection and the implementation of sustainable practices	
	The perceived additional time required for sustainable measures	(Al-Saleh and Taleb 2010)
	The client and service provider react passively in fulfilling environmental and social needs	(Abidin 2005)
	The belief that the principles of sustainability should require trade-offs	(Shen and Yu 2012)
	The strong perception that integrating sustainability issues into VM studies may slow down their progress	(Shen et al. 2015)
	The negative perception of green buildings in terms of the additional cost involved	(Shen and Yu 2012)
	The client's strategic planning does not incorporate sustainability objectives	(Abidin and Pasquire 2005)

Ignoring the VM facilitator's recommendations for achieving sustainability objectives due to the client's limited budget or other prior commitments	(Oke and Aigbavboa 2017)
The organization's corporate image could be damaged due to its failure to implement sustainable practices	(Pitt et al. 2009)
The end users' lack of involvement in the sustainable design and development process	(Williams and Dair 2007)
The lack of knowledge and understanding of the importance of sustainable development	(Shen and Yu 2012)
The lack of compulsory regulations for implementing sustainable development measures, and the status of implementation as an option	
The VM facilitator's fear of the extra responsibilities involved in highlighting the importance of sustainable development	

Table 2. Test of Cronbach’s alpha

Question number	<i>N</i>	Cronbach’s alpha
8	10	0.920
9	12	0.923
10	11	0.891
11	12	0.862

Note: N=number of items in each survey question

Table 3. Test of concordance for sustainability and VM survey

Question number	<i>N</i>	Chi-square χ^2	df	Significance level from <i>SPSS</i> output	Critical value of Chi-square χ^2 at $\alpha = 0.001$	Null hypothesis
8	10	63.805	9	<0.001	27.87	R
9	12	31.850	11	<0.001	31.26	R
10	11	20.898	10	<0.001	29.59	A
11	12	29.099	11	<0.001	31.26	A

Note: Total sample size = 73; *N* = number of items in each question; df = degree of freedom; A = accept; R = reject.

Table 4. Descriptive statistics of the SWOT attributes of integrating sustainability into the VM process

			Five-point Likert scale					TOTAL	ΣW	Mean	RII	Rank
	Code	VM Attributes	1	2	3	4	5					
Strengths	S3	VM provides opportunities for multidisciplinary professionals and stakeholders to become involved and focus on issues relating to society and the environment	1	2	11	33	26	73	300	4.1096	0.822	1
	S9	Stakeholders are strongly encouraged to propose sustainable solutions at an early stage	3	2	19	31	18	73	278	3.8082	0.762	2
	S6	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	3	3	17	34	16	73	276	3.7808	0.756	3
	S4	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	1	4	20	35	12	72	269	3.7361	0.747	4
	S2	The VM workshops provide diverse knowledge sources for sustainable development	2	3	17	42	9	73	272	3.726	0.745	5
	S1	The VM workshops recommend solutions for energy- and resource-efficient buildings	2	5	16	42	8	73	268	3.6712	0.734	6
	S8	Long-term proposal criteria, such as adaptability for future changes, whole-life costs and select renewable resources, are considered during VM exercises	2	5	19	37	10	73	267	3.6575	0.732	7
	S5	VM promotes sustainable project design	3	5	21	34	10	73	262	3.589	0.718	8
	S10	The optimum use of natural resources is recommended	3	6	26	27	11	73	256	3.5068	0.701	9
	S7	During VM studies, solutions are proposed that promote a safe and healthy environment for the occupants	3	10	22	33	5	73	246	3.3699	0.674	10
Weaknesses	W3	The lack of well-trained staff and expertise of VM participants in relation to sustainable development	5	8	22	31	7	73	246	3.3699	0.674	1
	W4	The lack of client support in achieving sustainable construction during the VM exercise	4	13	21	26	9	73	242	3.3151	0.663	2
	W7	Unclear project briefs, poor specifications or inadequate business cases for achieving sustainable development	5	11	20	30	7	73	242	3.3151	0.663	3
	W6	The lack of incentives for clients/contractors to achieve sustainable development goals	5	13	19	23	11	71	235	3.3099	0.662	4
	W2	The additional management and operational costs of sustainability measures for the project	1	16	20	30	5	72	238	3.3056	0.661	5
	W1	The lack of legal government enforcement of sustainability policies	6	12	18	30	7	73	239	3.274	0.655	6
	W8	The difficulty of enforcing environmental performance	6	13	18	28	8	73	238	3.2603	0.652	7
	W5	The lack of contractor, sub-contractor and supplier cooperation in achieving sustainability goals	5	13	24	25	6	73	233	3.1918	0.638	8
	W12	The VM facilitator and/or client does not highlight the role of corporate social responsibility in achieving the environmental and sustainable needs of society during the VM process	8	12	23	23	7	73	228	3.1233	0.625	9
	W10	The lack of sustainability integration into VM	2	23	23	21	3	72	216	3	0.600	10

		studies										
	W11	The lack of sustainable construction guidance	6	17	23	23	3	72	216	3	0.600	11
	W9	The lack of technological support for achieving sustainability objectives	9	24	18	21	1	73	200	2.7397	0.548	12
Opportunities	O6	Encouraging the reduction, reuse and recycling of construction and demolition waste	1	3	12	45	12	73	283	3.8767	0.775	1
	O7	The VM process encourages the application of environmentally friendly technologies on site	1	1	17	41	13	73	283	3.8767	0.775	2
	O3	Promoting the client’s interest in sustainability as a primary value driver	1	8	12	31	21	73	282	3.863	0.773	3
	O1	Including sustainability issues in the VM practices early on	1	3	18	36	15	73	280	3.8356	0.767	4
	O4	VM is a mechanism proved capable of delivering better sustainable value	2	1	18	43	9	73	275	3.7671	0.753	5
	O11	Highlighting the financial and non-financial incentives of sustainable development for clients and contractors during VM studies	2	3	18	39	11	73	273	3.7397	0.748	6
	O9	Establishing a waste management plan during VM exercises	0	2	30	30	11	73	269	3.6849	0.737	7
	O2	Introducing sustainability guidance for VM practitioners	1	6	21	32	13	73	269	3.6849	0.737	8
	O10	Including environmental scoring in the tender process	1	7	21	32	12	73	266	3.6438	0.729	9
	O8	Providing in-house training for environmental management	1	3	26	36	7	73	264	3.6164	0.723	10
	O5	The legal enforcement of environmental protection and the implementation of sustainable practices	2	5	25	32	9	73	260	3.5616	0.712	11
Threats	T4	The perceived additional time required for sustainable measures	1	12	13	37	10	73	262	3.589	0.718	1
	T2	The client and service provider react passively in fulfilling environmental and social needs	2	8	14	44	5	73	261	3.5753	0.715	2
	T3	The belief that the principles of sustainability should require trade-offs	3	11	22	29	8	73	247	3.3836	0.677	3
	T6	The strong perception that integrating sustainability issues into VM studies may slow down their progress	4	9	23	30	7	73	246	3.3699	0.674	4
	T5	The negative perception of green buildings in terms of the additional cost involved	3	8	21	32	9	73	255	3.4932	0.699	5
	T1	The client’s strategic planning does not incorporate sustainability objectives	1	11	23	27	11	73	255	3.4932	0.699	6
	T9	Ignoring the VM facilitator’s recommendations for achieving sustainability objectives due to the client’s limited budget or other prior commitments	3	12	22	29	7	73	244	3.3425	0.668	7
	T12	The organization’s corporate image could be damaged due to its failure to implement sustainable practices	2	9	29	29	4	73	243	3.3288	0.666	8
	T10	The end users’ lack of involvement in the sustainable design and development process	3	13	22	28	7	73	242	3.3151	0.663	9
	T7	The lack of knowledge and understanding of the importance of sustainable development	4	15	17	29	8	73	241	3.3014	0.660	10
	T11	The lack of compulsory regulations for implementing sustainable development measures, and the status of implementation as an option	4	10	27	25	7	73	240	3.2877	0.658	11
	T8	The VM facilitator’s fear of the extra responsibilities involved in highlighting the importance of sustainable development	7	21	22	16	7	73	214	2.9315	0.586	12

Table 5. Statistically significant Mann Whitney *U*-test results for integrating sustainability into the VM process

Question number	SWOT analysis attributes of integrating sustainability into the VM process	Client and VM facilitator	Client and VM participants	VM facilitator and participants
		<i>p</i> at $\alpha = 0.05$	<i>p</i> at $\alpha = 0.05$	<i>p</i> at $\alpha = 0.05$
8(d)	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	.030*	-	.003*
8(f)	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	-	.021*	.001*
8(g)	During VM studies, solutions are proposed that promote a safe and healthy environment for the occupants	-	-	.016*
8(h)	Long-term proposal criteria, such as adaptability for future changes, whole-life costs and select renewable resources, are considered during VM exercises	-	-	.027*
9(i)	The lack of technological support for achieving sustainability objectives	-	.031*	-
10(d)	VM is a mechanism proved capable of delivering better sustainable value	-	-	.017*
10(g)	The VM process encourages participants to apply environmentally friendly technologies on site	-	-	.048*
11(d)	The perceived additional time required for sustainable measures	-	.045*	-
11(e)	The negative perception of green buildings in terms of the additional cost involved	-	.014*	.018*
11(i)	Ignoring the VM facilitator's recommendations for achieving sustainability objectives due to the clients' limited budgets or other prior commitments	-	-	.038*

Notes: *Significant difference at the 95% confidence level. *Asymp. Sig. (2 tailed)* Total sample size=73 (clients=13, VM facilitators=19, VM participants/team members=41).

Table 6. Statistically significant Kruskal-Wallis test results

Question number	SWOT analysis attributes of integrating sustainability into the VM process	χ^2	<i>p</i> -value
8(d)	The strategic timing of the VM process enables the sustainability agenda to be highlighted at a critical decision-making stage	10.038	.007*
8(f)	An effective VM process allows sustainability measures to be integrated during the conceptual and early design stages	13.218	.001*
10(d)	VM is a mechanism proved capable of delivering better sustainable value	6.193	.045*
11(e)	The negative perception of green buildings in terms of the additional cost involved	9.507	.009*

Notes: *Significant difference at the 95% confidence level. *Asymp. Sig. (2 tailed)* Total sample size=73 (clients=13, VM facilitators=19, VM participants team members=41).

Table 7. Descriptive statistics of the SWOT attributes of integrating sustainability into the VM process (mean values)

SWOT attributes	Clients	VM facilitators	VM participants	Overall mean values	RII
Strengths	3.80	4.00	3.50	3.70	0.739
Weaknesses	3.39	3.12	3.13	3.17	0.637
Opportunities	3.88	3.84	3.63	3.73	0.748
Threats	3.61	3.23	3.34	3.36	0.674